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APPLIED MATERIALS, INC.
2881 SCOTT BLVD. M/S 2061
SANTA CLARA, CA 95050

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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Paper No. 23

Application Number: 08/893,917
Filing Date: July 11, 1997
Appellant(s): LITTAU ET AL.

Chung-Pok Leung
For Appellant

SUPPLEMENTAL EXAMINER'S ANSWER – ON REMAND

Pursuant to the Remand under 37 CFR 1.193(b)(1) by the Board of Patent Appeals and Interferences on January 30, 2003, a supplemental Examiner's Answer is set forth below: The basis for the remand of claims 8-15 (page 8, Section II, last line) is to provide an appropriate analysis of said claims pursuant to 35 U.S.C. § 112, paragraph 6. Claims 16-20 are remanded for a proper analysis under 35 U.S.C. § 103(a).

The preamble of claim 8 globally requires a substrate processing apparatus having a process chamber. In this respect, the anticipation under Moslehi is maintained because Moslehi provides teaching of a process chamber (14, Figure 1; column 8, line 45) that is used to process ("dry cleaning process"; Abstract, column 7, lines 52-64) a substrate ("wafer", 15). Claim 8 additionally requires:

i. Means for forming a plasma remotely with respect to said chamber, said plasma including a plurality of reactive radicals

Support for this portion of claim 8 is found in Section III (line 26, page 17 – page 18, line 5). Specifically, the specification teaches a plasma source 300 of Figure 3, where an "exemplary plasma source" would include a plasma applicator 302 in fluid communication with a fluorine gas supply 304 and a processing chamber 15. Specifically, the production of the remote plasma is by the plasma source "microwave generator, such as magnetron 306" which provides the power imparted to the fluorine gas supply 304. Moslehi teaches an equivalent apparatus that performs the function of "forming the plasma" by teaching a "microwave generator" (26, Figure 1) and plasma applicator (28). As a result, Moslehi's prior art elements of "microwave generator" (26, Figure 1) and plasma applicator (28) perform the identical function of "forming the plasma" in substantially the same way, and produces substantially the same results as the corresponding elements disclosed in the specification (MPEP 2183).

Claim 8 further requires:

ii. Means, in fluid communication with said means for forming a plasma, for forming a flow of said reactive radicals traversing toward the chamber

Support for this portion of claim 8 is found in Section III (lines 13-16, page 18). Specifically, the specification teaches a reactive gas supply 304 is flowed, under vacuum from the substrate processing chamber's pumping and exhaust system, into the plasma applicator 302 where microwave energy transmitted from a microwave generator. Moslehi teaches a reactive gas supply (20; Figure 1) is flowed, under vacuum from the substrate processing chamber's pumping and exhaust system (30), into the plasma applicator 28 (see " T " in piping) where microwave energy is transmitted from a microwave generator 26. As such, Moslehi teaches an equivalent apparatus that performs the function of forming a flow of reactive radicals ("Discharge Tube", 20; Figure 1) traversing toward the chamber 14 that is in fluid communication with said means for forming a plasma (as above). As a result, Moslehi's prior art elements of a reactive gas supply (20; Figure 1), pumping and exhaust system (30), and means for forming a plasma perform the identical function of "fluid communication means" for forming a flow of reactive radicals traversing toward the chamber in substantially the same way, and produces substantially the same results as the corresponding elements disclosed in the specification (MPEP 2183).

Claim 8 further requires:

iii. Means for forming a nonplasma diluent gas flow

Support for this portion of claim 8 is found in Section III (lines 21-23, page 18). Specifically, the specification teaches inlet 324 of the mixing manifold 322 is coupled to receive a flow, under vacuum, of diluent gas from the diluent gas supply 326. Moslehi teaches an inlet "non-plasma" of the mixing manifold 28 is coupled to receive a flow, under vacuum (see above), of

diluent gas from the diluent gas supply 20, "non-plasma". As such, Moslehi teaches an equivalent apparatus that performs the function of forming a nonplasma diluent gas flow. As a result, Moslehi's prior art elements of inlet piping, mixing manifold, and diluent gas source performs the identical function of forming a nonplasma diluent gas flow in substantially the same way and produces substantially the same results as the corresponding elements disclosed in the specification (MPEP 2183).

Claim 8 further requires:

iv. Means, in fluid communication with said means for forming a flow of said reactive radicals and with said means for forming a diluent gas flow, for mixing said flow of said reactive radicals and said diluent gas flow downstream of said means for forming a plasma and anterior to said chamber to form a gas-radical mixture; and

v. Means, in fluid communication with said means for mixing, for flowing said gas-radical mixture into said chamber

Support for this portion of claim 8 is found in Section III (lines 25-30, page 18). Specifically, the specification teaches a mixing manifold 322 is provided so that a flow of diluent gas may be mixed with a flow of reactive radicals. Moslehi teaches a mixing manifold "discharge tube" is provided so that a flow of diluent gas ("non-plasma") may be mixed with a flow of reactive radicals ("plasma") downstream of the means for forming a plasma (as above). As such, Moslehi teaches an equivalent apparatus that performs the function of mixing reactive radicals and diluent gas flow downstream of said means for forming a plasma and anterior to the

chamber to form a gas-radical mixture. As a result, Moslehi's prior art elements of "discharge tube" and "plasma" and "nonplasma" piping perform the identical function of mixing reactive radicals and diluent gas flow downstream of the means for forming a plasma (as above) and anterior to the chamber to form a gas-radical mixture in substantially the same way, and produces substantially the same results as the corresponding elements disclosed in the specification (MPEP 2183).

Claim 9, depending from 8, requires:

i. Means for forming a diluent gas flow includes a supply of diluent gas and a pump system in fluid communication therewith, with said supply of diluent gas comprising a nonplasma inert gas

Support for claim 9 is found in Section III (lines 13-16, 25-30, page 18). Specifically, the specification teaches a mixing manifold 322 is provided so that a flow of diluent gas may be mixed with a flow of reactive radicals. The specification further teaches a reactive gas supply 304 is flowed, under vacuum from the substrate processing chamber's pumping and exhaust system, into the plasma applicator 302 where microwave energy transmitted from a microwave generator.

Moslehi teaches a mixing manifold "discharge tube" is provided so that a flow of inert (helium or argon; column 13, lines 14-22) nonplasma diluent gas ("non-plasma") may be mixed with a flow of reactive radicals ("plasma") downstream of the means for forming a plasma (as above). Moslehi also teaches a reactive gas supply (20; Figure 1) is flowed, under vacuum from the substrate processing chamber's pumping and exhaust system (30), into the plasma applicator 28

(see " T " in piping) where microwave energy is transmitted from a microwave generator 26. As such, Moslehi teaches an equivalent apparatus that performs the function of mixing reactive radicals and inert diluent gas flow downstream of said means for forming a plasma and anterior to the chamber to form a gas-radical mixture. As a result, Moslehi's prior art elements of "discharge tube", "plasma", and "nonplasma" piping for either argon or helium gas perform the identical function of mixing reactive radicals and diluent gas flow downstream of the means for forming a plasma (as above) and anterior to the chamber to form a gas-radical mixture in substantially the same way, and produces substantially the same results as the corresponding elements disclosed in the specification (MPEP 2183).

Claim 10, depending from 8, requires:

"

ii. The apparatus as recited in claim 8 wherein said diluent gas flow travels at a first rate and said flow of said reactive radicals travel at a second rate with a ratio of said first rate to said second rate being at least 2:1.

"

Claim 10 does not use the phrase "means for" or "step for" and thus does invoke a 35 U.S.C. § 112, paragraph 6 analysis. Moslehi teaches the claim 10 requirements. Refer to Examiner's Answer (paper 18, page 9).

Claim 11, depending from 9, requires:

"

iii. The apparatus as recited in claim 9 wherein said supply of diluent gas comprises a reducing gas.

"

Claim 11 does not use the phrase "means for" or "step for" and thus does not comply with analysis (A) of MPEP 2181 for invoking 35 U.S.C. § 112, paragraph 6. Moslehi teaches the claim 11 requirements. Refer to Examiner's Answer (paper 18, page 7).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 16-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Moslehi (U.S. Pat. 5,403,434) in view of Stevens et al (U.S. Pat.5,302,803). Moslehi teaches a substrate ("wafer", 15) processing apparatus (14, Figure 1; column 8, line 45; "dry cleaning process"; Abstract, column 7, lines 52-64) including:

iv. a processing chamber (14, Figure 1; column 8, line 45) having an intake port (24/22; Figure 1)

v. a supply of nonplasma diluent gas ("nonplasma"; 20, Figure 1)

vi. a plasma source (26/28; Figure 1) including a conductive plasma applicator (28) defining an internal volume, the applicator having an input aperture ("plasma" and "nonplasma" feeds; Figure 1) and an output aperture ("Discharge Tube"/"Discharge cavity" interface; Figure 1)

vii. a mixing manifold ("Discharge Tube"; Figure 1) having multiple inlets ("plasma", "nonplasma" feeds; Figure 1) and an outlet (reactor 14 header) with the outlet being coupled to the intake port (24/14 interface) and one of the inlets being in fluid communication with the outlet aperture of the conductive plasma applicator (Figure 1), with the remaining inlets being in fluid communication with the supply of diluent gas ("nonplasma"; 20, Figure 1)

viii. a pump system (30, Figure 1), in fluid communication with both of the plasma source and the supply of diluent gas (refer to flow conduits; Figure 1), to create a diluent gas flow ("nonplasma") and a flow of the reactive radicals ("plasma"), with the flow of the reactive radicals traversing the output aperture toward the mixing manifold ("Discharge tube") and the flow of gas traveling from the supply to the mixing manifold, with the diluent gas flow and the flow of the reactive radicals combining ("Discharge Tube" + "Discharge cavity"; Figure 1) when traveling between the inlets and the outlet forming a gas-radical mixture egressing from the outlet ("Discharge Tube"/"Discharge cavity" interface; Figure 1) and traveling through the intake port (24/22; Figure 1)

ix. a controller (40; Figure 1; column 9, lines 5-21) configured to regulate the pump system (see communication lines, Figure 1) and the plasma source (see communication lines, Figure 1)

x. a memory ("process control computer"; column 9, line 18), coupled to the computer (40; Figure 1; column 9, lines 5-21), comprising a computer-readable medium ("....and

downloads the desired multi-cycle process recipes"; column 9, lines 5-21) having a computer-readable program embodied therein for directing operation of the substrate processing system, the computer-readable program including a set of computer instructions ("....and downloads the desired multi-cycle process recipes"; column 9, lines 5-21) to be operated on by the controller to regulate the introduction of the radicals from the plasma into the mixing manifold ("Discharge Tube"; Figure 1), the set of computer instructions ("....and downloads the desired multi-cycle process recipeS"; column 9, lines 5-21) including:

a. a first subroutine ("....and downloads the desired multi-cycle process recipeS"; column 9, lines 5-21) to be operated on by the controller to regulate the pump system (see communication line between the pump system 30 and the controller 40) to introduce the reactive radicals into the mixing manifold at a first rate (column 11, lines 66-68; 100-1500sccm) and the diluent gas at a second rate (column 11, lines 66-68; 25,000.25sccm) so as to maintain a pressure with the chamber less than one torr (1μTorr column 9, line 15)

Moslehi does not teach a microwave arrestor.

Stevens teaches a microwave arrester (46, column 9, lines 24-37).

It is the examiner's position that a person of ordinary skill in the art at the time the invention was made would have found it obvious to modify the Moslehi microwave source by introducing Stevens et al's microwave arrester. The Stevens et al microwave arrester is a common practice in

the art limiting the extent of microwave radiation permeation to the volume of gas intended for discharge as taught by Stevens (column 5, lines 24-38; column 6, lines 44-57) in order to provide for efficient power delivery and uniformity to the plasma volume (column 9, lines 9-12; column 3, lines 19-35).

4/11/3